

Trend of atmospheric benzo[a]pyrene in Italy before the adoption of the European Directive on PAHs

Edoardo Menichini¹, Vito Belladonna², Lucia Cellini³, Claudio Gabrieli⁴, Annalisa Spiazzi⁵, Anna Stella⁶, Gian Rolando Trevisani⁷, Valeria Tricarico⁸, Renato Villalta⁹, Consuelo Zemello¹⁰

¹Istituto Superiore Di Sanità

²ARPA Emilia-Romagna, Bologna

³ARPAM Ascoli Piceno

⁴ARPAV Padova

⁵ARPAV Verona

⁶Istituto Nazionale per la Ricerca sul Cancro, Genova

⁷Agenzia Provinciale per l'Ambiente, Bolzano

⁸ARPAT Firenze

⁹ARPA Friuli Venezia Giulia

¹⁰ARPAV Venezia

The recent European Directive 2004/107/EC, relating to PAHs and some metals in ambient air, requires Member States to take all necessary measures to comply, as from 2013, with a target value for benzo[a]pyrene (BaP) used as a marker for the carcinogenic risk of PAHs: 1 ng/m³ as annual mean in the PM₁₀ fraction. A national regulation is already in force in Italy setting the same concentration as a 'quality objective' for particulate-phase BaP in urban areas: consequently, BaP measurements are currently performed on a regular basis in about 15 Italian towns, at one to six sites per town. In this work we selected those sites for which at least five annual means are available. The purpose was to evaluate both the temporal trend of BaP pollution in urban air, before implementing the measures required by the Directive, and the practicability of the target value under the current environmental conditions (as traffic, vehicular and heating fuels, industrial plants).

Annual means were obtained from 10 towns, six of which 'agglomerates' according to the definition of the Directive (> 250 000 inhabitants). The overall number of sampling sites for fixed measurements was 21: 12 'traffic-oriented' (including high- and medium-traffic areas), six 'urban-background', and three 'industrial'. BaP was determined by GC or HPLC in 24-h samples regularly collected throughout the year on glass fibre filters.

At the 12 traffic-oriented stations (nine towns), BaP was monitored since five to 12 years: at all (but one) stations, the initial annual means exceeded 1.0 ng/m³, ranging from 1.2 to 3.5 ng/m³. Then a decreasing trend was observed almost everywhere, resulting in a BaP reduction roughly in the order of 50%. In 2004 almost all means ranged from 0.5 to 1.0 ng/m³, but still exceeded 1.0 ng/m³ in two towns, up to 1.9 ng/m³. The decreasing trends were not always continuous: peaks, both positive and negative, occurred occasionally in individual years, not simultaneously in the different towns.

At the six background stations (five towns), BaP was monitored since five to seven years. Trends were not homogeneous: generally roughly stable but also, in a few cases, showing some decreases. In the two towns where the traffic-oriented sites showed the highest concentrations, also background values were the highest, in the range 0.9-1.7 ng/m³ (means in 2004: 1.0 and 1.4 ng/m³): this was likely because the two stations, although located in green areas, were affected to some extent by vehicle exhausts. At the other four background stations, BaP ranged from 0.2 to 0.7 ng/m³. The background means accounted approximately for 30% to 90% of those at the traffic-oriented sites in the same town.

The three industrial sites were located in two towns, downwind a coke plant and a carbon electrode manufactory, respectively. As expected, BaP markedly decreased from 8.0 to 0.2 ng/m³ after the coke plant closure and from 4 to 0.3 ng/m³ after the adoption of measures to control the emissions of the electrode manufactory.

Overall, a declining trend was measured during the last few years. However, in heavy-traffic areas (typical of the highest pollution levels by PAHs in Italian towns), the attainment of the forthcoming European target value appears hardly practicable under the current conditions of traffic congestion. Concentrations around 1 ng/m^3 occurred even not in the immediate vicinity of vehicular exhausts: this was consistent with the known BaP adsorption on micrometric and sub-micrometric particles which are subject to re-suspension and transport to the general urban environment.